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DOD GATEWAY INFORMATION SYSTEM (DGIS) COMMON COMMAND  
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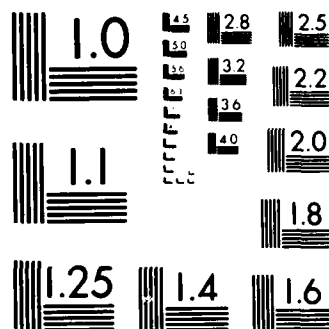
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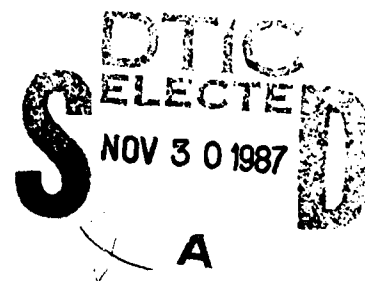
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DOD GATEWAY INFORMATION SYSTEM (DGIS)  
COMMON COMMAND LANGUAGE:  
PROLOG KNOWLEDGE BASE PROFILE

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The initial phase of the Common Command Language (CCL) project was prototyped in C language. A test and evaluation of the prototypes showed that much more was needed to handle the wide variety and disparity of native command languages and operating characteristics of the multitude of information systems. PROLOG was chosen as a simple but powerful relational programming language based on the idea of programming in logic. PROLOG additionally fits well with the plan for gradual migration from a structured command language to a natural language. The current phase of the project utilizes Artificial Intelligence techniques of blackboard architecture and knowledge bases. PROLOG is the primary implementation language, coupled with low level system-related support functions written in C.

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DOD GATEWAY INFORMATION SYSTEM (DGIS) COMMON COMMAND LANGUAGE:  
PROLOG KNOWLEDGE BASE PROFILE

SUMMARY

DTIC's Common Command Language (CCL) project for the DGIS precipitated DTIC's entry into the Artificial Intelligence environment. The initial phase of this project was prototyped in C language. An evaluation of these prototypes showed, however, that much more was needed to handle the wide variety and disparity of the native command languages and operating characteristics of the multitude of information systems.

After reviewing Artificial Intelligence tools and languages, PROLOG was chosen as a simple but powerful relational programming language based on the idea of programming in logic. PROLOG additionally fits well with the intended plan for gradual migration of CCL from a structured command language to a natural language.

The current phase of the project utilizes Artificial Intelligence techniques of blackboard architecture and knowledge-based driven knowledge sources. PROLOG is the primary implementation language, coupled with low level system-related support functions written in C.

## **DOD GATEWAY INFORMATION SYSTEM (DGIS) COMMON COMMAND LANGUAGE: Prolog Knowledge Base Profile**

### *Background*

The Defense Technical Information Center (DTIC) has been sponsoring the DOD Gateway Information System (DGIS) project since 1982. The purpose of this system is to provide users in the Department of Defense a simple, efficient, and yet powerful means to access information residing in governmental and commercial databases. Within the system the user not only has help in accessing the information but also the capability to manipulate the results afterward. The DGIS is currently in prototype operation at the Defense Applied Information Technology Center (DAITC) in Alexandria, Virginia. The DGIS Common Command Language (CCL) is a project generated from the realized need within the DGIS user community to be able to access the multiplicity of information systems with a standard command language. DTIC therefore initiated the CCL project in 1986.

### *The Problem*

DGIS offers the user access to a large number of information systems. Each of these systems is equipped with its own command language and procedures to access information. Often the differences between the command languages are substantial enough to pose a barrier to both casual users and professional librarians. Furthermore, the command languages are maintained by a variety of vendors and government agencies wherein changes may be introduced without warning to users.

The goal of the CCL project is to solve the above problem by introducing a single command language access to bibliographic databases through the DGIS. CCL will incorporate procedures to ensure its correctness with respect to changes and availability of features in a database.

The project started with the commitment to implement the National Information Standards Organization (NISO) proposed CCL standard. This standard evolves from the most often needed and the most popular features of existing bibliographic databases. In early 1987, several quick DGIS CCL prototypes were successfully implemented in C using the standard UNIX tools of LEX and YACC for language translation. These prototypes established the feasibility of the project and insights into the problem.

The second phase of the project, which is now in progress, utilizes Artificial Intelligence techniques of blackboard architecture and knowledge-based driven knowledge sources. Quintus Prolog has been chosen to be the primary implementation language coupled with some low level system related support functions written in C. The introduction of Prolog is required to implement CCL as a knowledge based system, because it fits well with the intended plan for gradual migration of CCL from a structured command language of NISO, to a natural language.



### *The Design Goals*

The CCL implementation has several design goals:

- 1) provide a single CCL program for bibliographic data bases.
- 2) provide a high degree of maintainability with respect to syntax and semantic changes of both CCL and the underlying command languages.
- 3) adaptability to future enhancements to the current version of CCL that are being planned.

### *The Approach*

Considering the above design goals, the DGIS CCL is structured as a knowledge-based system. CCL can be thought of as a black box between the user and the host database. The control program of CCL, called CP, is a blackboard-based architecture Prolog program that controls the interaction between the CCL agents and the communication agents (we use the term *knowledge source* rather than agents to be consistent with literatures on blackboard systems). The CCL knowledge sources are the experts based on a number of knowledge-based systems. Typically there are two types of CCL knowledge bases. One is pertinent to the user information, and the other is the knowledge base about databases. The user knowledge base (UKB) system stores information relevant to a particular user, or a group of users. Examples of this information are one's areas of interest (database names), short-hand (CCL scripts, aliases), his privileges, etc. All this information is needed by the CCL to intelligently converse with and interpret commands from the user. The database knowledge base (DKB) contains information needed to translate CCL commands into host database commands and to understand the returning results and errors from the database.

The *control program* is a typical *blackboard* based program. It is a Prolog implementation of an object-oriented system where the blackboard is nothing more than a general object that registers and monitors progresses of the related knowledge sources. Each knowledge source is an object that is activated and deactivated by messages. The knowledge source's progress and results are also composed in terms of messages whenever possible for the blackboard of the CP. The DGIS environment provides an important communication facility called Network Access Machine (or NAM). CCL uses NAM to perform the DGIS-to-host connections. The results from NAM are packaged in terms of messages to be processed by CCL.

The construction of CCL knowledge bases is the result of the cooperation with the domain experts provided by the sponsor, DTIC, to interpret the command languages and capture the librarian usage of command languages. A number of Prolog tools that help maintain and validate knowledge bases were also implemented.

### *Future Directions*

DGIS CCL is an on-going project. Several simple models of the above described system have been prototyped. Work is in progress to improve the following aspects:

- 1) the command translation between two command languages are sometimes not one-to-one. To provide a truly uniform capability across various host databases, CCL attempts to fill in the gap of capabilities not provided by the host command language. Often this means that CCL has to maintain temporary files and results. The program also decomposes a CCL command into several primitive host commands. The execution of these host commands are structured as a *planning process* of actions. Each action is the execution of a single primitive host

command, and the success and failure of the action can cause different plans to be considered or aborted.

2) DGIS CCL is planned for the gradual migration of CCL from a structured language of NISO CCL to natural language. We have prototyped a version of a bottom parser (based on the Japanese's BUP parser). It is intended to have this parser to fully cooperate with a blackboard system of the CP.

3) DGIS CCL is currently limited to a single database access. We are investigating the possibility of simultaneous database access capability. This extension will allow the user to converse with a CCL, that is coupled with a directory of databases for meta-information about databases, could then activate several CCL executions. The results would then be combined and intelligently presented to the user.

4) The design of the knowledge bases that DGIS CCL relies upon are not very efficient. We are investigating the knowledge base interface to a relational database system and/or database machine.

### *Contacts*

The project's technical work is being performed by Duc Tran, a consultant to Control Data Corporation, with the help of Randy Bixby of DTIC under the direction of Allan Kuhn of DTIC.

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